005
new
(3)

PAT-NO: JP405269086A

DOCUMENT-IDENTIFIER: JP 05269086 A

TITLE: DEVICE FOR MEASURING MECHANICAL PROPERTIES OF ELASTIC MATERIAL AND METHOD THEREOF

PUBN-DATE: October 19, 1993

INVENTOR-INFORMATION:
NAME
FISHER, JACK
MAXWELL, G PATRICK
PERRY, LARRY

ASSIGNEE-INFORMATION:

NAME	COUNTRY
FISHER JACK	N/A
MAXWELL G PATRICK	N/A
PERRY LARRY	N/A

APPL-NO: JP04129153

APPL-DATE: May 21, 1992

INT-CL (IPC): A61B005/00

ABSTRACT:

PURPOSE: To measure mechanical properties of fragile wound such as a relatively new wound, fetus wound and the like with an excellent accuracy and repeatability.

CONSTITUTION: A subject 14 with a mark on a tissue part having a wound is positioned on a scale 12 and a ring 30 is fixed on the tissue part of a subject 14. Negative pressure gradually increasing with time is applied to the tissue part by a vacuum chamber 16. The pressure of the vacuum chamber 16 is controlled by a vacuum controller 18 and the variation of pressure with time is stored in an processing system 26. Images of the tissue part with time are taken by a video camera 22 and each of the images is digitized by an image digitizer 24. The processing system 26 calculates the mechanical properties by pressure data as a time function from the vacuum controller 18 and aberration data of the wound position obtained from images by digital processing.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the method and equipment which measure an outline and the dynamic property of the matter. It is related with the method and equipment which measure the specific living body dynamic property of the wound conglutination in an organization in detail.

[0002]

[Description of the Prior Art] In the medical field, to measure the strength of the wound under conglutination in an organization correctly for many reasons is desired. as it is newly interesting to cell division, a growth factor, and embryo reproduction recently -- wound conglutination and the living body dynamic research on the strength of an organization -- **** -- it is important

[0003] the subject of such a wound conglutination examination -- the animal for an experiment -- it is a rat most typically Conventionally, the abdomen of an animal etc. is cut open and specification conglutinates the wound for several days typically during the period. next, the skin part which encloses a wound -- careful -- excising -- this ablation part -- vice -- it lays in equipment [like] With this equipment called Instron tension gage, the direction of a wound extends the ablation skin in the crossing direction, and the breaking strength of a wound is measured.

[0004]

[Problem(s) to be Solved by the Invention] Especially, since [being regrettable] this method needs to excise a wound and needs to measure it in vitro one, i.e., the outside of a living body, it brings about some factors which reduce an experimental precision and experimental usefulness. For example, decomposition of the skin starts by ablation and a living body dynamic property is affected. Moreover, the strength is influenced by ablation of the skin and handling, and, in the case of a comparatively new wound, the stress in which it is also possible bursting this is brought about.

[0005] The method of examining the strength of the wound by another conventional in vitro one is performed using gas entrainment positive pressure equipment. However, this method also needs to excise the skin. In this method, in many cases, the excised skin is back equipped with a thin elastic membrane, and is laid between rings, and positive pressure is applied until a wound explodes. Since a wound part is excised, it reaches far and wide and operation by the hand is performed also in this case, many errors arise in an examination.

[0006] Although the result of the bursting strength to the wound conglutinated for several

days is in tolerance mostly by these methods, the test result about the wound which the error about a brittle wound and a new wound exceeded tolerance, and was attached within two - three days before the examination for this reason, and a brittle embryo wound has many very not clear things. That, as for the still more disadvantageous point of the method by such in vitro ones, many of medicines under examination show the most remarkable effect to wound conglutination is the fact that a wound is during two - the still very brittle the 3rd of the beginning after wound formation. Furthermore, by the skin property method in in vitro one, since ablation of a wound is needed, the hypodermically affix and fibrin deposit which contribute to wound strength are surely destroyed.
[0007] To measure a wound with an outstanding precision and outstanding repeatability is especially desired about a wound with brittle comparatively new wound, embryo wound, etc. Moreover, when the living body dynamic property of the skin is measured in in vivo ones and the skin has connected with the hypodermically matter, to measure an actual symptom more strictly is desired. Furthermore, a bird clapper is expected living body dynamic measurement possible, without measuring living body dynamic skin properties, such as elasticity, without giving a lesion called ablation to a subject, therefore causing destruction with a limited target to Homo sapiens.
[0008]
[Means for Solving the Problem] this invention offers matter, such as the skin in which the wound was formed, and dynamic [specific] and the specific equipment which measures a living body dynamic property in in vivo one of an organization. This equipment is effective for especially examining the property of a wound with brittle wound added two - three days before [small] the examination, wound of an embryo organization, etc.
[0009] According to one field of this invention, the equipment which measures the living body dynamic property of the wound under conglutination of a subject equips the organization part containing a wound with the chamber which applies the negative pressure increased gradually with time, and this part has an indicator so that extension of this part can measure easily. This equipment was distorted from each digital display, determined the value as the pressure-survey equipment which measures the pressure of a chamber as a function of time, the camera for obtaining many images of this part with time, and the digitizer which generates the data barrel display of an image, made each distortion value correlate with the pressure-survey value corresponding to the point same after all, and is equipped with the processor which offers a stress-distortion relation again.
[0010] According to other fields of this invention, the equipment which measures the dynamic property of the elastic matter The chamber which applies the negative pressure increased gradually with time to a part including the mark which is the part of the matter and makes measurement of deformation of this part easy, The pressure-survey equipment which measures the pressure of a chamber as a function of time, and the camera for obtaining many images of this part with time, It has the digitizer which generates each digital display of an image, and the processor which the rate of extension is determined [processor] from each digital display, and makes each rate of extension correlate with the pressure-survey value corresponding to the point same after all.
[0011] According to still more nearly another field of this invention, the method of measuring the dynamic property of the elastic matter The process which attaches the

mark which enables the trace of extension of the matter for the matter easily, and the process which applies to the part of the matter including this mark the negative pressure increased gradually with time, The process which determines the specific dynamic property of this matter from the process which measures the pressure applied to this part as a function of time, the process which obtains two or more images of this part with time, the process which generates the data barrel display of an image, and the measured pressure and the generated digital display is included.

[0012]

[Function] In the dynamic property measuring device of this invention, while the negative pressure increased gradually to the part of the matter with which the mark was prepared is applied and the pressure of this chamber means is measured by the chamber means as a function of time, deformation of the part is regarded as an image by the camera means. And the image digitizes, the rate of extension is determined, and the dynamic property of the matter is determined based on the measured pressure.

[0013]

[Example] In these description of this invention that describes other purposes, an advantage, the feature, and an aspect of affairs below by reaching, I will become whether to be Ming.

[0014] Drawing 1 is the block diagram of vacuum control wound chamber equipment (VCWCD) 10 for measuring the specific living body dynamic property of the wound under conglutination in in vivo one. VCWCD10 has one or more sets of the scale 12 which carries the subject 14 with a wound, the vacuum chamber 16 which applies negative pressure to a wound part, the vacuum controller 18, the source 20 of a vacuum, and the video cameras that photo the image of a wound, a charge-coupled device 22, a videocassette recorder and the picture digitizer 24, and a processing system 26.

[0015] The embodiment of VCWCD10 shown in drawing 1 is designed so that RADDO for an experiment may be used as a subject which has a wound under conglutination examined. However, VCWCD10 is changed by various methods, it is possible to examine also to other subjects or xenobioticses of an animal, and these the alterations of all may be performed within the limits of this invention. Furthermore, although operation of VCWCD10 describes the abdomen of the rat for an experiment about the wound cut open and obtained below, the part of a wound is one experimental mere specific parameter, and in order to evaluate the living body dynamic property of the wound organization under treatment in other parts of this animal, it is in Ming that other wound parts may be chosen. In addition, in this specification, the experiential data offered to VCWCD10, the Instron tension gage, and gas entrainment positive pressure equipment (AIPPD) are accumulated through the examination performed with each equipment according to the indicator of the U.S. scientific research meeting about protection and use of the animal for an experiment.

[0016] A scale 12 is an electronic scale of "Sartorius 1000MP9" etc. of "Tennessee Scale Works" manufacture which deducts a self-weight and can be made into the weight of a subject and which can be adjusted preferably. The vacuum chamber 16 is directly arranged on the subject 14 placed on the scale 12, and the ring 30 (further shown in a detail at drawing 3) fixed to the skin of a subject is contacted. The vacuum chamber 16 has the shape of a cylinder which usually has the bore of 2.5cm, for example, and it is applied so that a pressure seal may be formed between rings 30. It is made for the video

camera 22 directly arranged on it to have the image of a wound photoed, the vacuum chamber 16 being preferably constituted by glass and the upper part at least being used as transparent. The vacuum chamber 16 is equipped with the entrance 32 for being open for free passage with the source 20 of a vacuum again. The vacuum chamber 16 is able to be able to adjust both the vacuum chamber 16 and the video camera 22 perpendicularly, and for the position of a subject to be put together by this, and to lower the vacuum chamber 16 and a video camera 22 to the position which sticks with a ring 30 and contacts, while making into the minimum the pressure which joins a ring 30 and a wound part.

[0017] The pressure of the vacuum chamber 16 is controlled by the vacuum controller 18 which adjusts the free passage rate of flow with the source 20 of a vacuum. The vacuum controller 18 has preferably the "248-10000simian-virus control bulb" and the "250C controller" by which all were manufactured by MKS Instruments, and a "TORR‹type 122-AA-01000AB pressure transducer." The source 20 of a vacuum is a pump which holds an essential very big capacity by the low pressure very much, and the size of the capacity and its low level of a pressure are enough in that sufficient negative pressure for making a wound destroy may be formed in the vacuum chamber 16. Consequently, if the vacuum controller 18 changes between the source 20 of a vacuum, and the vacuum chambers 16 into a free passage state, the air in a vacuum chamber will let an entrance 32 and the suitable pressure line which drawing 1 sketched as 36 and 38 pass, and will be attracted in the rate of flow controlled by the vacuum controller to the source of a vacuum.

[0018] Operation of the vacuum controller 18 is controlled by the processing system 26 through the control signal which it sketched by the reference number 40. The vacuum controller 18 gives the analog electrical signal 42 proportional to the negative pressure in the vacuum chamber 16 to a processing system 26, a processing system 26 is changed into the digital signal which corresponds this analog signal, and this digital pressure data is memorized as a function of time.

[0019] A video camera 22 acquires the video picture of the wound part of a subject through the vacuum chamber 16, and transmits this video picture to a videocassette recorder and an image digitizer 24 through a line 44. In other embodiments of this invention, in order to obtain the image from which some of wound parts differ, to use two or more sets of video cameras is desired. A videocassette recorder and the picture digitizer 24 are desirable, and the suitable interface to a processing system 26 is equipped by "the 6300/60 Hertz videocassette recorder of Panasonic AG / playback unit", and the "VP-110 dynamic picture processor" of Motion Analysis Corporation. If a suitable instruction is received from a processing system 26 in the form of a sound signal through a line 46, a videocassette recorder and the picture digitizer 24 (it is only henceforth called a picture digitizer) will record the picture signal from a video camera 22 on a suitable VHS record medium, and will digitize this picture signal as digital image data of two frames between specific speed, for example, 1 second. It is accumulated and these frames that are the digital images of a wound part are memorized till an experimental end. Typically, when a vacuum is first added to a wound by the digital image of 150 frames, an examination until a wound is destroyed from from is fully covered by it. If all the data for one examination are accumulated, the picture digitizer 24 will transmit a digital image frame to a processing system 26 through a line 48.

[0020] At the time of a test end, the processing system 26 has obtained the pressure data

as a function of the time from the vacuum controller 18, and the digital image of the wound under examination as a function of the time from the picture digitizer 24. Therefore, the processing system 26 has obtained sufficient data which can calculate the specific living body dynamic properties of the wound examined, such as a stress-distortion relation and an elastic modulus. Since the processing system 26 is equipped with sufficient storage region to accumulate the data obtained from several examinations again, it becomes easy [comparing statistically a series of examinations which have the same examination parameters, such as a wound conglutination period,].

[0021] A processing system 26 is further shown in a detail at drawing 2 . In drawing 2 , a dotted line shows a data transfer and a solid line shows a control path. The processing system 26 has the display monitors 54 and 56 corresponding to the examination processor 50 which controls a general examination and calculates the final living body dynamic property of a subject, the picture processor 52 which processes digital image data, and each examination processor 50 and the picture processor 52, and keyboards 58 and 60, respectively. The picture processor 52 is an "IBM (trademark)" compatible microcomputer based on an "Intel (trademark)80386 (trademark)" microprocessor chip preferably. The picture processor 52 is equipped with the exclusive video-processing board which is constituted so that it may insert in the slot which can use an IBM (trademark) compatible microcomputer preferably and which makes easy processing of digital image data of the video-processing board of "Motion Analysis Corporation" manufacture etc. The picture processor 52 determines the position of the specific dot indicator in a picture (attached to the skin so that it may mention later), and makes the coordinate of a dot indicator correlate with the time from an experimental start during operation by receiving the digital image frame of the wound part accumulated during an examination shown by the reference number 48 from the picture digitizer 24, and processing these frames. With the keyboard 60 and the display monitor 56 which were connected to the picture processor 52 The interaction with the picture processor 52 of a user becomes possible, and a user edits [that a user inputs specific data into the picture processor 52 by this] digital position gap data again. It becomes possible to remove data without relations, such as data accumulated after the data and the wound which were accumulated before the vacuum was added to the vacuum chamber were destroyed. The data 62 edited now correlatively are transmitted to the examination processor 50.

[0022] The examination processor 50 is also the "IBM (trademark)" compatible microcomputer which used the microprocessor chip on the basis of "Intel (trademark)80386 (trademark)" preferably. The examination processor 50 controls the vacuum controller 18 and the picture digitizer 24. Further, the examination processor 50 receives the pressure data 42 from the vacuum controller 18, digitizes this pressure data 42, and makes consistency have with the time from an experimental start. The examination processor 50 calculates the living body dynamic property of the wound examined by adjusting pressure data and the digital position gap data of an indicator dot. With the keyboard 58 and the display monitor 54 linked to the examination processor 50, a user performs an interaction with the examination processor 52, digital pressure data are edited, and it becomes possible to remove data without relations, such as data accumulated after the data and the wound which were accumulated before the pressure was applied to the wound were destroyed.

[0023] In preparation of the subject rat for an examination, phenobarbital anesthesia is

performed to a rat through the peritoneum. Next, the hair of the part of rats, such as an abdomen, is shaved and washed. The guide line for using a template, for example, cutting abdomen Chuo Line open 2.5cm is drawn, and it is cut open by sufficient thickness according to a guide line. Next, a wound is closed by the staple for surgery etc. and a rat is returned to a cage. Food is arbitrarily given until it performs the strength examination of the wound under conglutination to a rat.

[0024] When performing the strength examination of a wound, the annular ring 30 which applies anesthesia to a rat, for example, has a bore corresponding to the length of a 2.5cm incision blemish mostly is fixed by [which apply cyanoacrylate] depending especially and/or using the staple for surgery. The staple for surgery used in order to close the incision section is removed at this time. The uniform front face for the effect of the annular ring 30 limiting the skin **(ed) by the vacuum to the part of a configuration which cut circular [circular / of the skin / a part of], i.e., spherical surface, and the influence of the stress on the wound by the surrounding skin part being removed by this, and changing between the vacuum chambers 16 into an airtight state is offered.

[0025] Drawing 3 is the ring 30 adhered to the abdomen organization 63 of the rat 14 for an experiment, and the position of a wound 64 is set to divide into two equally the part surrounded with a ring 30. The indicator dot 66 of a couple is attached to the skin of a rat in ink. As shown in drawing 3 , it is prepared so that the longitudinal direction of a wound and the line which connects between one each and a dot to the both sides of a wound 64 may cross at right angles the simultaneously central point of a wound 64. Although one pair of indicator dots 66 are being used for the embodiment of the examination stated on these specifications so that extension of the organization under examination can be pursued easily, the number of the marks for positioning is good without limit. Furthermore, a matrix-like line may be attached to a wound part by the finite element method or other known methods, and the individual part which makes calculation of stress etc. easy may be formed in much positions covering a wound part, respectively.

[0026] Next, an abdomen is turned up, a rat 14 is put on a scale 12, and the weight which deducted the self-weight of a scale is measured. Next, the vacuum chamber 16 and a video camera 22 are dropped until the base of a vacuum chamber sticks with a ring 30. It checks that check a scale 12 and the vacuum chamber 16 is not applying the force to a rat 14. When the force is applied, an error may arise in a test result.

[0027] The flow chart of drawing 4 and drawing 5 shows the outline of the operation of VCWCD10 between wound strength examinations. In the following description, when referring to the specific step of the flow chart of drawing 4 and drawing 5 , the reference number is shown in a parenthesis. Moreover, the solid line in drawing shows a transfer of the function between each step of a flow chart, and a dotted line shows the flow of only data. "A" enclosed with with a circle [of the bottom of the flow chart of drawing 4] shows a transfer of the function to the same sign of the topmost part of drawing 5 .

[0028] An examination will be started if an instruction is given to the examination processor 50 by the operator through the suitable key input of a series in a keyboard 58 etc. (100). At this time, the examination processor 50 generates a reference voltage and sends it to the vacuum controller 18 (105). The vacuum controller 18 starts the reduced pressure control in the vacuum chamber 16 in response to a signal. Simultaneously, the examination processor 50 sends a sound signal to the picture digitizer 24, and it directs to

start record of the image data received from a video camera 22 to a picture digitizer (110). Next, the examination processor 50 starts the sampling of the analog electrical signal generated by the vacuum controller 18 proportional to the pressure in the vacuum chamber 16 (115). Simultaneously, preferably, from the vacuum controller 18, between speed equal to the speed which samples and digitizes pressure data, for example, 1 second, the number of the examination processors 50 is two, and they digitize and memorize the picture of the wound part by which the picture digitizer 24 was photoed with the video camera 22 (120).

[0029] The force is applied to the skin 63 enclosed by the ring 30, the vacuum, i.e., the negative pressure, of the vacuum chamber 16. Since a skin organization is the biological substance of elasticity, the skin to which the force was applied is extended, bends backward in the configuration where a part of spherical surface was cut toward the interior of the vacuum chamber 16, and is made into how to open the negative pressure of a vacuum chamber wide. If the skin continues being extended by the vacuum to increase gradually, the indicator dot 66 of the both sides of the wound 64 on the skin 63 will separate from a wound mutually. When the vacuum chamber 16 is continuously decompressed by the free passage with the source 20 of a vacuum by the vacuum controller 18, the sample of the analog signal of its reduced pressure voltage / pressure generated by the vacuum controller 18 is carried out by the examination processor 50, and the picture of a dot 66 which separates from the wound part gradually is memorized in video form, and it is digitized by the picture processor 24, and memorizes by the digital format. If the pressure in a vacuum chamber fully decreases and a wound breaks, an examination processor will terminate a vacuum test (125).

[0030] After a vacuum test is completed, the picture digitizer 24 transmits the accumulated picture frame to the picture processor 52 (130). Next, by processing a digital image by the standard method, the picture processor 52 determines the center between each indicator dot 66 of each picture, and determines the position gap from the distance of the beginning between the centers between each dot before applying a pressure to the wound part of the center (135). The suitable algorithm which offers such an image-processing function is known in the field concerned, and the software which performs these functions by the executable code suitable for execution by various processors is marketed. The software suitable for using it with the suitable image-processing board of "Motion Analysis Corporation" manufacture is also marketed by "Motion Analysis Corporation."

[0031] By using the display monitor 56 and a keyboard 60 for the picture processor 52, connecting An operator can investigate the data of a position gap, and can specify the destructive time of the wound which appears as a sudden big position gap change on data, and edits data. Data without relations, such as what was accumulated after the wound broke, or before sufficient pressure required for an experimental start was applied to the wound, can be removed (140). Next, a position gap is displayed on the display monitor 56 which corresponds as a function of time (145), and, as for the picture processor 52, an operator can edit position gap data again by this graphical representation of the display monitor 56 if needed (140). When an operator edits data, the edited position gap data are again displayed as a function of time (145). This process is continued until an operator is satisfied with position gap data. Since the edited position gap data make it correlate with the pressure data edited into the degree, it is sent to the examination processor 50 by

them.

[0032] An opportunity for an operator to investigate pressure data by the examination processor 50, and edit is also given (150). An operator can choose removing data without relations, such as pressure data accumulated after destruction of a wound, from pressure data like edit of above-mentioned position gap data. Moreover, the pressure at the time of the wound destruction showing the breaking strength of a wound can be specified. The pressure data edited into the degree are displayed on the display monitor 54 as a function of time (155), and, as for the examination processor 50, an operator can edit pressure data again by this graphical representation (150). If satisfied with the pressure data into which the operator was edited, the examination processor 50 will receive position gap data from the picture processor 52, and will generate the data of the position gap (strain) to a pressure (stress) combining the data of time [as opposed to / a position gap / for a pressure pair time data] (160). When the point of pressure data and position gap data is accumulated by the point same as a result, these are only put together. When these points shift slightly and are accumulated after all, it is together put using the standard interpolation method.

[0033] next, a pressure is displayed on the display monitor 54 as a function of a position gap, and the stress pair distortion curve to the subject of the corresponding wound is generated (165) an operator -- minding -- an algorithm -- or an elastic modulus, curved inclination and the degree of energy absorption, or all the fields under a stress-strain curve are calculated by determining the portion of a stress-strain curve which makes a straight line most by the visual sense (170) The test result which includes an elastic modulus, final position gap, i.e., deformation, at the time of a bursting pressure and destruction, and the degree of energy absorption is memorized by the file which is examined and which was appropriately discriminated for every subject. These memorized results can be compared with the test result of other individuals, or the result of a series of examinations at any time, and in order to make comparison of data easy and to promote the accuracy of a result again, statistical datas, such as the average and standard deviation, are calculated (180).

[0034] In order to explain the result which may be obtained by the VCWCD method, the rat for an experiment of 300g a large number was prepared as mentioned above from the weight of 250g, it divided into five different groups, and wound conglutination strength was measured over five days every day. The result of the bursting strength of these examinations is shown in drawing 6 . In drawing, the pillar 70 shown with a slash is breaking strength shown by mercurial column MIRIMETA, and the standard deviation of the examination performed on each day is shown by the length of the bracket line 72 prolonged from the point of the pillar shown with a slash. As shown in drawing, especially, in two - three days of the beginning after wound conglutination, the standard deviation of a VCWCD examination is very small, an examination is exact, and it is shown that there is repeatability.

[0035] In order to show that a VCWCD examination is more exact than an AIPPD examination and the Instron tension gage examination, 45 300g rats for an experiment were divided into three groups from the weight of 250g, each test method was used, and wound conglutination strength was inspected after (wounds 2 and 7 and 14 days). The rat for an experiment was prepared and it was cut open as mentioned above. The mark of an indicator dot was attached only to the subject used by the VCWCD method at this time.

In the Instron tension gage and the AIPPD examination, although it was made the sacrifice before examining a subject, by the VCWCD method, it was made the sacrifice immediately after the experimental end.

[0036] In the Instron tension gage examination, the skin of abdomen of the subject for an experiment containing a blemish part was carefully excised from the animal made into the sacrifice so that the Banking Inspection Department grade might not be distorted. Next, this organization was placed into the clamp of Instron equipment, and the force was gradually applied until the wound broke. Breaking strength was calculated based on the amount of grams of the force required in order to make a wound destroy. In the examination which used the AIPPD method, similarly, the abdominal wound was carefully cut open keenly so that the Banking Inspection Department grade might not be distorted. Next, the 2cmx1cm hole of the point of a pillar-like pressure chamber was fixed for the wound cut open on the wrap compression O ring. Air was inhaled to the chamber and the pressure required in order to make a wound destroy was recorded with the number of pounds per square inch using the in-line gage connected through an inhalation port until the wound broke. The examination which uses the VCWCD method was performed as mentioned above.

[0037] Although the data generated from the VCWCD method and the AIPPD method are expressed with the number of pounds per square inch, the data generated from the Instron tension gage method are expressed with the number of grams per cross section. Therefore, in order to have compared three methods, data were standardized as what is expressed as standard deviation from the average and the average as percent of the average of each data group. The result of these [of wound destruction] three methods will be shown in the following table [back / two day / of a wound] 1 about the two-day, seven-day, and 14-day back from a wound again at drawing 6 . Drawing 7 is the graph of the average bursting force as a function of the conglutination time expressed with days. Setting in this graph, the bracket line 74 shows the standard deviation of after (two days, seven days, and 14 days). Curves 76, 78, and 80 show that a remarkable correlation is among all the three inspection methods, and that curved inclination is similar. There was no remarkable difference statistically between the inclination of the line of these three methods.

[0038]

[Table 1]

ＶＣＷＣＤ、ＡＩＰＰＤおよびインストロン張力計法を使用した、創傷２日後の創傷強さ測定の比較。データは平均値のパーセントとして標準化された。

観　察　例	ＶＣＷＣＤ[1]	ＡＩＰＰＤ[2]	インストロン[2]
1	1．5	2．1	3．0
2	1．1	2．9	0．9
3	1．6	1．5	1．6
4	1．5	3．0	1．5
5	1．4	2．0	4．6
平均値±標準偏差	1.42±0.19	2.3±0.63	2.48±1.62

注）

1．Ｐ＜０．５

2．観察例に対して８被験体が必要であった

[0039] As shown in Table 1, the VCWCD examination group in the examination on the 2nd had few standard errors in wound measurement than the AIPPD method and the Instron tension gage method. That is, although standard deviation was slight or it was 0.19 by the VCWCD method, it was 1.62 in 0.63 and the Instron tension gage method by the AIPPD method. Furthermore, in the examination on the 2nd in the AIPPD method and the Instron tension gage method, in order to obtain the result of the example of 5 observation, eight animals were needed, respectively. This is because such sufficient stress that a wound causes rupture in each three example by the process which excises a wound and lays this in each equipment **(ed).

[0040] As a peculiar feature of the VCWCD method, the rate of elasticity and the degree of energy absorption of a wound can be measured from a breakdown test. It sets to the following table 2 and the average, standard deviation, and the standard deviation expressed as percent of the average are given to the strength of the subject of a VCWCD examination two days and seven days after, distortion, and an elastic modulus. This table shows that standard deviation is comparatively small in all the fields of a VCWCD examination two days and seven days after. Furthermore, it turns out that a VCWCD examination is reliable also to an unripe wound, and reproducible data are generated.

[0041]

[Table 2]

破壊強さ、皮膚変形および弾性率の比較を示す典型的なＶＣＷＣＤ試験

2日後				
変数	n[1]	平均値	標準偏差	%平均値[2]
破壊強さ（mmHg）	5	68.02	6.93	10%
皮膚変形（mm）	5	4.76	0.51	11%
弾性率（kPa）	5	36.76	6.28	17%
7日後				
変数	n[1]	平均値	標準偏差	%平均値[2]
破壊強さ（mmHg）	5	246.00	32.38	13%
皮膚変形（mm）	5	4.06	0.62	13%
弾性率（kPa）	5	214.00	29.79	14%

注）

１．５被験体が試験された。

２．%平均値＝標準偏差を平均値のパーセンテージとして示す。

[0042] Although the specific embodiment of this invention stated on these specifications is applied to measurement of the living body dynamic property of wound conglutination of an organization, this invention has wide range adaptability in measurement of the property of the matter that many, such as silicone, polyurethane, a latex, rubber, a biomechanics target in which other deformation is possible, and dynamic matter, differ. this invention can offer useful information about a means to burst specific elastic matter, such as matter which has a small hole for measuring a tear strength again.

[0043]

[Effect of the Invention] this invention can measure the dynamic property of a wound with brittle dynamic property of the elastic matter, comparatively new wound, embryo wound, etc. with an outstanding precision and outstanding repeatability especially in this way. Moreover, when the living body dynamic property of the skin is measured in in vivo one and the skin has connected with the hypodermically matter, it becomes possible to measure an actual symptom more strictly. Furthermore, since living body dynamic skin properties, such as elasticity, can be measured without giving a lesion called ablation to a subject, it becomes possible about living body dynamic measurement, without causing destruction with a limited target to Homo sapiens.

[Translation done.]